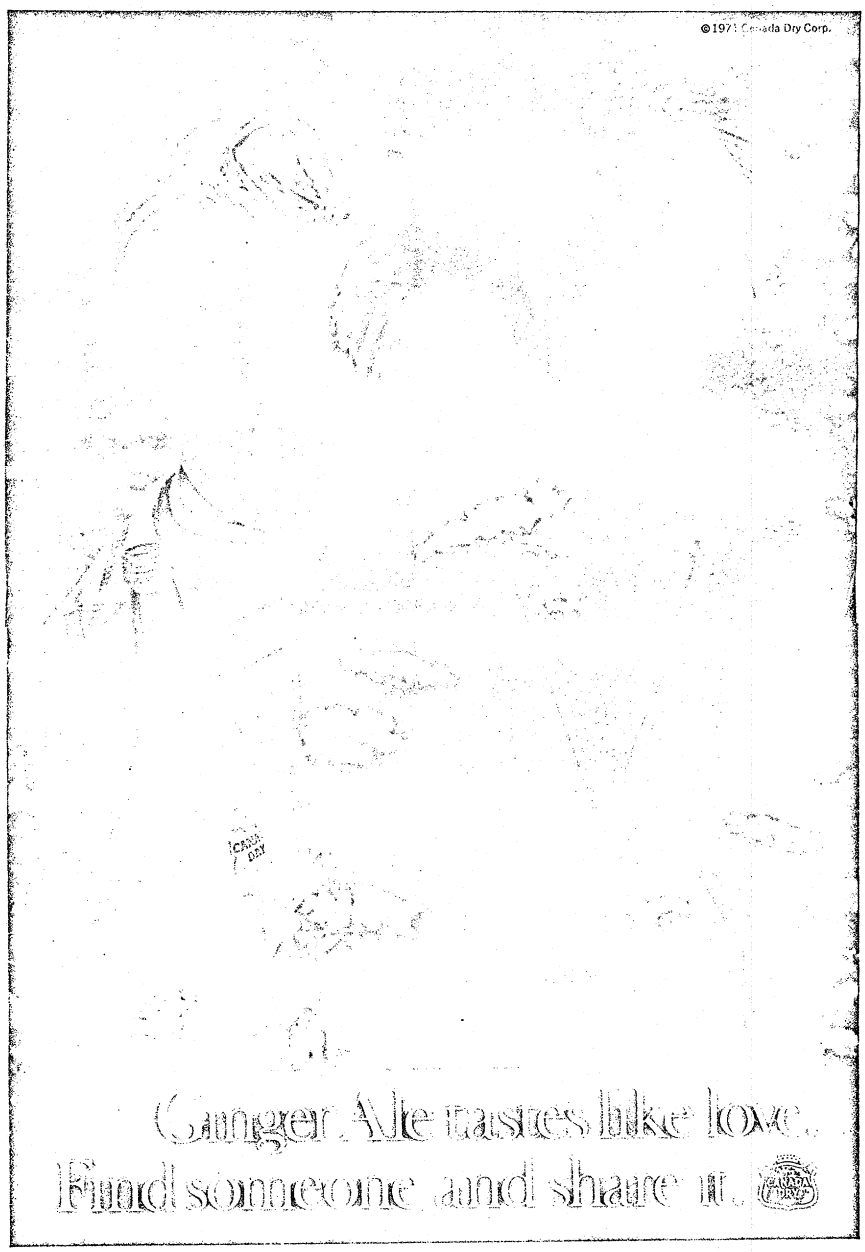
Fortifying soft drinks with protein

By NORMAN E. ROBERTS
Agricultural Research Service, U.S. Dept. of Agriculture

■ Some beverages are good for you, and some are just good. Most soft drinks are delicious and refreshing, but now they can be given a nutritional boost as well. U.S. Department of Agriculture researchers have come up with a way of fortifying soft drinks with proteins without affecting their flavor, appearance, or their keeping quality.



Circle no. 124 on Reader's Service Card

whey proteins

The proteins come from whey, a byproduct of cheesemaking. They are highly nutritious milk proteins from an abundant source. In making cheddar swiss, cottage, and other cheeses, cheesemakers squeeze over 20 billion pounds of liquid whey from their curds every year. Much of the whey goes into candy and baked goods and other food and feed products, but there is just so much of it that it's hard to use it all up.

For over 40 years scientists of USDA's Agricultural Research Service at the Dairy Products Laboratory in Washington, D.C., have been uncovering new uses for whey. Their work has shown that whey is a valuable byproduct with many more potential uses that remain to be explored.

Recent legislation preventing the disposal of excess whey into streams has made cheesemakers eager for new uses for their byproduct. As a result, processes for fractionating whey into its components are now being actively developed.

adding whey to soft drinks

Two of these processes, known as ultrafiltration and gel permeation, can be used in sequence to remove the salts and most of the lactose (milk sugar) from whey. The resulting concentrate can then be dried to a powder that is about 80 percent pure protein.

Chemist Virginia H. Holsinger used these processes to obtain the protein concentrates with which she fortified soft drinks at the Dairy Products Laboratory. Working with her associates, Linda P. Posati and E. David DeVilbiss, and under the direction of Dr. Michael J. Pallansch, Miss Holsinger has demonstrated the technical feasibility of the scheme. They prepared protein-fortified carbonated fruit and cola drinks, and also added the protein concentrate to "ade"-type noncarbonated powdered beverages.

carbonated beverages

The chemists prepared carbonated soft drinks by combining sucrose, flavoring (strawberry, orange, lemon, and lime), and citric acid in accordance with formulations used in the industry. They dissolved the whey powder in water to make a 2-percent solution, adjusted its pH to that of the beverage with citric acid, then combined it with the beverage at double strength so that the drink would ultimately contain 1 percent protein. To make cola beverages, a 2-percent protein solution acidified with phosphoric acid was added to a commercial syrup diluted to double strength. All the beverages were carbonated with solid carbon dioxide.

Adding 1 percent protein to carbonated soft drinks has virtually no effect on their flavor, color, or clarity, either initially or after storage. Tasters could not detect the whey at all in freshly made beverages, and it was not until after 200 days of a 1-year room-temperature storage test that a slight flavor of stale whey began to be noticed in the fortified beverages.

After the year in storage, the beverages still remained clear. They also retained their original color to a remarkable degree, although some showed a slight color shift after 6 months.

At the acid pH range of the beverages, the whey proteins are stable to heat as

1883

Laboratory works isolate protein from whey.

well as to storage. This indicates the fortified beverages could be pasteurized without loss of clarity. At 3.5, the pH of the citrus drinks, the proteins were almost completely stable to 2 hours of heating at 75 and 80°C. (167 and 176°F.). Lowering the pH to 2 or raising it to 4 resulted in some denaturation, but the solutions remained clear. The pH had to be raised above 4 before the denatured proteins precipitated out of the solution.

Miss Holsinger then added the individual components of the soft drinks to the protein solutions to see what effect each had on protein stability. She found that the sugar makes the protein even more stable to heat; that at a given pH, 2.68, citric acid (used in the citric drinks) does not contribute as much to protein stability as phosphoric acid (used in the cola drinks); and that the different flavoring agents have practically no effect.

It should be emphasized here that denaturation of the protein is not related to its nutritional quality. One measure of nutritional quality is the available lysine. Tests made before and after both storing the fortified beverages and heating the protein solutions indicated little change in the protein's available lysine. This suggests that processing and storage will not limit the healthful effects of the added protein.

noncarbonated beverages

Perhaps a more rigid test of the effect of whey proteins on flavor was provided by the noncarbonated beverages. The scientists added carefully spray-dried whey protein concentrates to two brands of the "ade"-type beverages that are reconstituted at home by dissolving in water. The whey powder was added at such levels that when reconstituted the beverages would contain 1 percent and 0.5 percent protein

There were 7 flavors — cherry, grape, tart lemon, lemon-lime, orange, raspberry, and strawberry. Most of them were virtually unaffected in color by the protein, although a slight color shift did occur in the lemon-lime flavor.

A panel of experienced dairy products judges rated these beverages organoleptically. For each of the 7 flavors, the judges tasted unmarked samples containing 0, 0.5, and 1 percent whey protein. They assigned a grade to each sample in accordance with a hedonic scale ranging from 9 (like extremely) to 1 (dislike extremely). Samples the judges neither liked nor disliked rated 5.

Significantly, all the fortified beverages averaged better than 5, indicating that none were disliked. In general, the controls (no protein) averaged between 6 and 7, while the fortified beverages were between 5.5 and 6.5. The samples with 0.5 percent protein were slightly preferred over those with 1 percent protein, and in a few cases the grades for the beverages with 1 percent protein dipped down near the indifferent level of 5. This suggests that it may not be possible to add much more protein than this without affecting the acceptability of noncarbonated beverages.

Among the fortified noncarbonated beverages, the judges in general slightly preferred the citrus flavors over the noncitrus. Although the judges said they could detect the whey flavor in most of these noncarbonated beverages, they did not consider it objectionable. Some of the beverages they thought were actually

(Continued on page 25)

ortifying soft drinks with protein

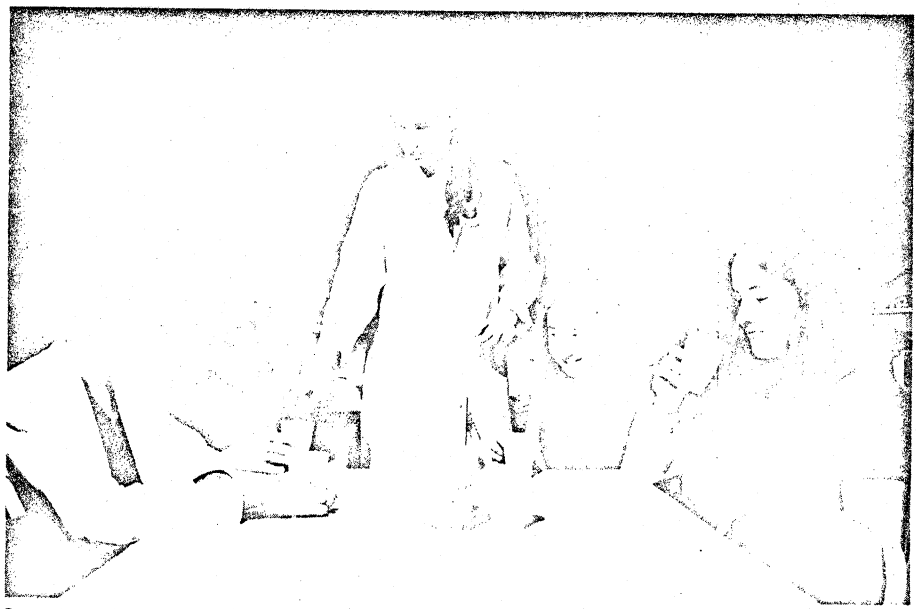
improved in flavor by the whey protein.

cost

How much will it cost to fortify soft drinks with whey protein concentrate? This is, of course, impossible to predict with any degree of accuracy, especially since the technology of isolating proteins from whey has not yet progressed far beyond the experimental stage. Even at a cost of $1 to $1.50 for the protein, USDA researchers feel that fortification at the 1 percent level should be less than a cent per 8-ounce bottle.

As in the case of diet beverages, the drinks might well be merchandised, at least at first, at a premium price that would well exceed the added cost of production. Later, the premium price might become unnecessary as volume production of protein concentrates leads to technological efficiencies. In the USDA research, the proteins were isolated on a pilot-plant scale by sophisticated and complicated techniques. More protein was lost in the process of separating the lactose and salts from the whey than would be commercially acceptable.

Production economies might also be realized by not drying the protein to a powder. In liquid form it might be simpler to add to the soft-drink concentrate or syrup. On the other hand, shipping and storing the protein as a liquid concentrate would present problems. Also, some bottlers might prefer to dissolve the protein powder in their own water.



Samples of carbonated beverages with whey protein nutritional additive are sampled by teen-agers.

The USDA research was designed only to demonstrate the feasibility of using whey proteins to fortify soft drinks. Much industrial experimentation will no doubt be necessary to arrive at the most practicable commercial procedures. In such work, the staff of the Dairy Products Laboratory stands ready to cooperate with beverage manufacturers in any way.

significance of soft-drink fortification

How much would a 1-percent fortification of soft drinks with protein mean to the nutrition of our people? It may seem like a meager contribution, but its significance lies in the tremendous consumption of these beverages. The 75 billion 8-ounce bottles produced every year is enough for about a bottle a day for every man, woman, and child in the country. Nutritionists are especially concerned about our children and teenagers, who certainly consume more than their share of soft drinks. If youngsters insist on passing up milk and fruit juices for these other beverages, the industry that serves them has a golden opportunity to contribute to the health and well-being of the coming generation. At the same time, the industry stands to profit much from an advertising campaign to promote its efforts.

Adding a few protein-laden calories to those "empty" ones the nutritionists decry may not be *good*, but *good for* beverage manufacturers.

NEXT ISSUE: BOTTLER EQUIPMENT PURCHASE SURVEY